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Make-or-Buy Decisions

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Abstract

In this paper we test Williamson's proposition, based on his transaction cost framework, that the interaction of uncertainty and asset specificity is a determinant on make-or-buy decisions. The test was performed on 60 first stage assembly components in a division of a major US automobile manufacturer. By specifying two types of uncertainty-volume and technological, and controlling for production costs, we find evidence to support his hypothesis. However, the results show that volume and technological uncertainty are managed differently by the division; the implications of this finding for Williamson's theory is discussed.

The transaction cost approach to the study of organizations covers a wide spectrum of issues, ranging from varieties of organizational structure (Armour and Teece, 1978), to franchise contracting (Williamson, 1976). A transaction is the transfer of a good or service between technologically separable units (Williamson, 1982), and the analysis of transactions focuses on achieving efficiency in their administration. The analytical framework has two sides: first, the administrative mechanisms whose efficiency is at issue and second, the dimensions of transactions which determine how efficiently a particular administrative mechanism performs. Matching these sides of the problem is the critical task.

Given sufficient continuity or frequency of a transaction to generate concern for the efficient use of resources repeatedly allocated to it, two general dimensions determine which mode of governing the transaction is most efficient: 1) the uncertainty associated with transaction execution and 2) the uniqueness or specificity of the assets assigned by the buyer or supplier to the good or service transacted. Williamson's argument (1975) is that in an imperfect world, where individuals have limited information processing capacity and are subject to opportunistic bargaining, high uncertainty makes it more difficult for the buyer of the good or service to determine the correctness of the supplier's actions and high asset specificity makes self-serving supplier decisions particularly risky for the buyer. Transactions which are frought with uncertainty and to which non-marketable assets have been dedicated will be more efficiently governed when performed completely by the buyer than when performed between a buyer and supplier in the product market. Both the

evaluation and the vulnerability problems are reduced when the buyer has direct control over the operation by performing it in-house.

In the present study we apply the transaction cost framework to make-or-buy decisions for components in a manufacturing division of a large US automobile company. Make-or-buy decisions are a special form of vertical integration decision which is the paradigmatic problem for transaction cost analysis (Williamson and Ouchi, 1981). Although a number of ways of managing the buyer-supplier relationship have been identified, based on behavioral (Ouchi, 1980), strategic (Harrigan, 1983), or industrial economic (Blois, 1972) assumptions, here we focus on the simple but prototypical choice between making a component within the firm and buying the product in a market which is regulated to a degree by competitive forces.

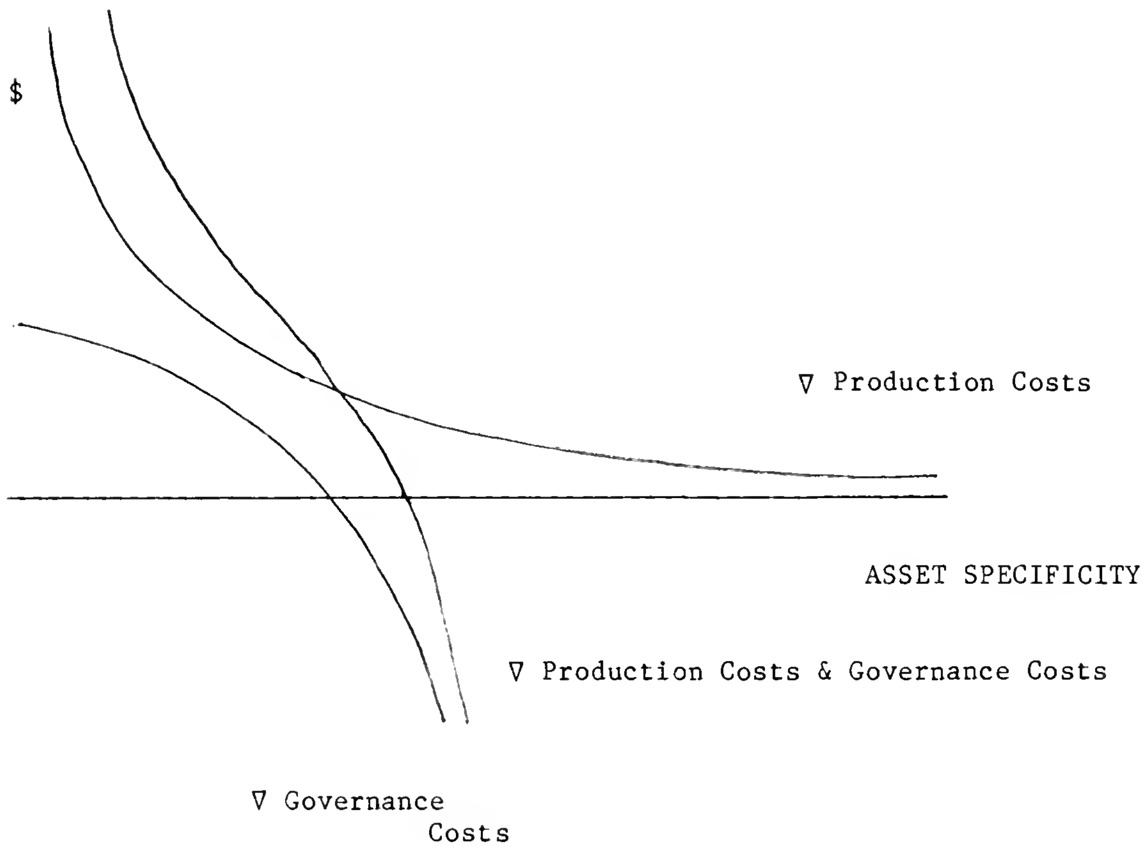
Both Anderson (1982) and Monteverde and Teece (1982) have found empirical support for the transaction cost approach to vertical integration. The present research relies most heavily, however, on Williamson's (1982) model of efficient boundaries. The efficient boundaries concept implies, in addition to vertical integration, the possibility of shifting the performance of an activity from the firm to a supplier in the market, that is, of vertical de-integration. When changes occur in the administrative structure and technological base of the firm as well as in the supplier market, de-integrating an activity may be advisable.

Williamson's model is shown in Figure 1. Production and transaction cost differences between making and buying are both related, in dissimilar ways, to the level of asset specificity. When asset specificity is low, suppliers enjoy a production cost advantage over buyers since they are able to pool possibly uncorrelated demand, thereby achieving smoother production volume and greater economies of scale. The production cost differential decreases as roughly an inverse function of increases in asset specialization, and approaches zero,

Figure 1

Tradeoff Between Governance Costs and Production Costs

(Adapted from Williamson, 1982, p. 560)



∇ = cost of market contracting over cost of in-house production

never favoring the buyer. A comparison of the transaction costs between make and buy indicates bringing the operation in-house at a relatively early point on the asset specificity continuum because production costs favor the supplier at this point; however, buyers should continue to purchase the component until the sum of the production and transaction cost differentials indicates that the operations should be brought in-house.

It is noteworthy that, for covenience, in the model shown in Figure 1, uncertainty is held constant at a moderate level as an influence on transaction costs. Williamson (1979) argues that high costs, due to uncertainty, of executing market transactions occur only when opportunism is present. In a competitive market, where asset specificity is low, buyers can recontract with alternative suppliers should changes in contract specifications be required. On the other hand, if either little or no uncertainty is associated with the transaction, the buyer can specify all (or almost all) the contingencies that might impinge on contract execution and thus defend itself against supplier opportunism. Thus uncertainty and supplies asset specificity are joint conditions for a decision to make a component, based on transaction cost considerations.

Although Anderson (1982) in her study of forward integration into sales found support for the effect on vertical integration of the interaction between asset specificity and uncertainty, to date no test of this proposition has been made for make-or-buy decisions concerned with backward integration. Furthermore, in her field experiment Anderson assessed the reliability of the variables separately from rather than simultaneously with the test of her hypotheses. Finally, she used a multiplicative term to represent the interaction between asset specificity and uncertainty, thus specifying that low values of both specificity and uncertainty lead to a make decision, a clear contradiction of Williamson's theory. In the present study we attempt

to overcome these constraints and difficulties by using a multi-sample multiple indicator structural equation model on a sample of first stage assembly components. We test the following hypotheses:

1. There should be a significant difference between the influence of uncertainty on the make-or-buy decision for components bought in highly competitive supplier markets (low asset specificity) and in markets with low supplier competition (high asset specificity).
2. Higher uncertainty should be associated with a make decision in low competition but not high competition markets.

Two types of uncertainty, volume and technological, are measured in the present study. Similar to Anderson's measure of uncertainty as the perception of sales forecast accuracy, volume uncertainty involves the assessment of fluctuations in the demand for a component and the confidence placed in estimates of component demand. Contracts which are subject to moderate or large shifts in volume strain buyer-supplier relationships as unexpected production costs or excess capacity are incurred by the suppliers and stock-outs or excess inventory experienced by the buyer. To the extent the component market is competitive, a buyer may go to other suppliers either to increase the volume purchased or threaten to do so on the next round of contracting, thereby reducing the costs of mid-contract renegotiation with the current supplier.

We also define uncertainty in terms of change in component specifications. Technological change in component design requires retooling, which in the present case is paid for by the buyer, and, if the component is currently bought, recontracting with the supplier as a result. Such recontracting should be less costly for the buyer in competitive rather than non-competitive markets, since alternative sources for the redesigned component are available and supplier power is low. Thus technological

uncertainty should lead to a make decision only when high transaction costs are incurred in non-competitive supplier markets.

In addition to volume and technological uncertainty, we include the production cost differential between the buyer and suppliers as a determinant of the make-or-buy decision. The effect of comparative production costs on the decision should be strong no matter what the level of supplier market competition and therefore is not hypothesized to differ across high and low competition components. It is important, however, to include production costs in the model to reduce specification error. The indicators of supplier market competition, volume and technological uncertainty, and buyer-supplier production cost differential are shown in Figure 2. The structural equation model to be tested is presented in Figure 3.

Data and Methods

The data consist of 60 decisions made by a component division of a large US automobile manufacturer over a three year span. These decisions were formulated in a newly instituted formal make-or-buy decision making process. From the roughly twenty thousand part numbers the division used for assembly, the sample of 60 emerged by exception as the information for them was considered inadequate for a competent decision to be made; they therefore were referred to the committee for futher evaluation.

The formal process was a team effort involving several functions among which were component purchasing, sales and product engineering. To minimize key informant bias (see Phillips, 1982) we exploited this functional differentiation. A team member provided information on that aspect of the decision which was relevant to his or her function. For each of the 60 parts, component purchasing answered questions concerning the level of market

Figure 2

Indicators of Latent Variables in the Structural Equation Model

Production Cost Differential Between Buyer and Suppliers

1. Natural logarithm of the division's estimate of the annual savings to make as opposed to buy a component.

Volume Uncertainty

2. The extent to which significant fluctuations in the daily/monthly volume requirement for the component are expected.

3. The extent to which volume estimates for the component are considered to be uncertain.

Technological Uncertainty

4. The frequency of expected changes in specifications for the component.

5. The probability of future technological improvements of the component.

Make-or-Buy Decisions

6. Actual decision made by the division.

Competition Among Suppliers

7. The extent to which it is difficult to judge the competitiveness of outside quotes on a component.

8. The extent to which there are enough potential suppliers to ensure adequate competition for the sourciong of the component.

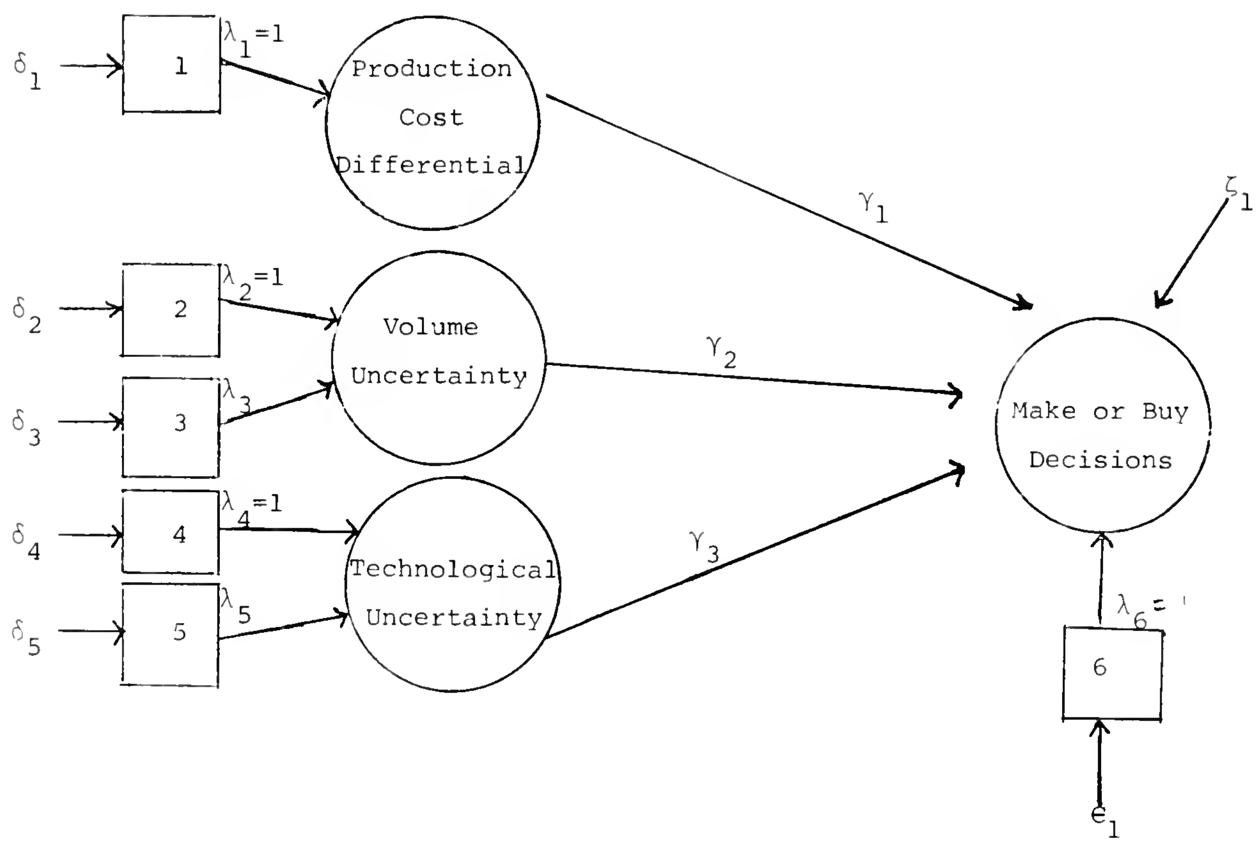
9. The extent to which leading outside suppliers of the component possess proprietary technology that gives them an advantage over other producers.

Figure 3

Structural Equation Model of Predictors of

Make-or-Buy Decisions

(Correlations Among Exogenous Variables Omitted for Simplicity)



competition; product engineering indicated the level of technological uncertainty with regard to the components; and sales provided data on the degree of volume uncertainty. The annual savings to make a component which measured the difference between supplier and buyer production costs was derived by component purchasing and manufacturing engineering. All responses, except annual savings to make, were made on a Likert type scale of 1 to 5. Make or buy decisions were coded 0 of make, 1 if buy.

The first step in the analysis consisted of stratifying the sample of components into two groups based on the competitiveness of the supplier market. Market competition was measured using an additive composite of the indicators for competition shown in Figure 2. The components were split into high and low competitive groups at the composite's median.

The second step involved testing the structural equation system shown in Figure 3 on the components in both groups using the maximum likelihood estimation procedure of Joreskog and Sorbom's LISREL V (1982). The first hypothesis of this study was tested by comparing the results for two alternative submodels (see Figure 4). In the first submodel both the measurement and structural equation coefficients are proposed to be equal in both groups. The second submodel specifies that across the groups all coefficients should be equal except the causal paths relating the latent variables.

If the first submodel cannot be falsified, as measured by a chi-square goodness of fit test produced by LISREL V, then the first hypothesis of the study, that the level of competition affects the influence of uncertainty on make-or-buy decisions, is disconfirmed. However, if the first set of subhypotheses is falsified and the second is not, then the first hypothesis is confirmed.

Figure 4

Alternative Submodels to Test Differences in Parameter Estimates Across High and Low Competition Groups

Model 1

Set all parameters equal across groups

Model 2

Set all parameters equal across groups except γ's

The second main hypothesis which concerns the differential effect of uncertainty on make-or-buy decisions across levels of market competition was assessed by examining the structural equation estimates and their associated T-values in the test of the second submodel.

Since the maximum likelihood estimation procedure assumes that the underlying distribution of the variables is multivariate normal, biserial correlation coefficients were computed for the relationships between the dichotomous make-or-buy variable and the other variables in the model for both high and low competition groups.

Results

The correlation matrix for the three indicators of supplier competition is shown in Table 1. The reliability (Spearman-Brown) of the construct is .88. The correlation matrices for the high and low competition groups are shown in Table 2. Note that the two measures of technological uncertainty are correlated .92 and .95 in the high and low groups, respectively, suggesting that these indicators carry highly similar information about the construct. As a result, the second measure was dropped from the analysis.

The results of the test of the first submodel are shown in Table 3. We see that this model, which assumes all parameters to be equal across the two groups is rejected (X^2_{16} = 27.70, prob. = .034). Consequently, either measurement or structural equation coefficients differ across the high and low competition conditions.

Table 4 presents the findings for the second submodel. Here the measurement properties of both high and low groups were specified as equal, but the structural equation coefficients were estimated separately for each group. The fit of this model to the data cannot be rejected (X^2_{13} = 19.11, prob. = .12), indicating that the effects of the two types

Table 1

Correlation Matrix for Supplier Competition

Non-competitiveness of outside quotes	1.0		
Sufficient number of suppliers	-.82	1.0	
Extent of supplier proprietary technology	.56	-.61	1.0

Table 2

Correlation Matrices of Indicators

For High and Low Competition Groups

High Competition Group

Indicators (refer to Figure 2)

	1	2	3	4	5	6
1	1.0					
2	-.13	1.0				
3	0.0	.39	1.0			
4	.44	-.25	-.32	1.0		
5	.38	-.14	-.24	.92	1.0	
6	-.65	.18	.13	-.22	-.24	1.0

Low Competition Group

Indicators (refer to Figure 2)

	1	2	3	4	5	6
1	1.0					
2	- .60	1.0				
3	- .39	.78	1.0			
4	- .09	.11	-.14	1.0		
5	- .08	.15	-.13	.95	1.0	
6	- .69	.35	.25	.04	.04	1.0

Table 3

Results for First Submodel (See Figure 4)

For Both Groups	Parameter Estimate	Standard Error	T-Value
λ_1	1.0	-	-
λ_2	1.0	-	-
λ_3	.53	.26	2.01
λ_4	1.0	-	-
λ_5	-	-	-
λ_6	1.0	-	-
γ_1	-.61	.09	-6.18
γ_2	-.22	.14	-1.58
γ_3	.08	.09	.92
ϕ_{11}[1]	1.0	.186	5.39
ϕ_{22}	1.11	.54	2.07
ϕ_{33}	1.0	.186	5.39
ϕ_{12}	.26	.14	1.90
ϕ_{23}	-.05	.13	-.40
ϕ_{13}	-.09	.13	-.69
ψ_1[2]	.60	.16	3.79
δ_1	0	-	-
δ_2	-.112[3]	.51	-.22
δ_3	.69	.19	3.65
δ_4	0	-	-
δ_5	-	-	-
ε_1	0	-	-

$\chi^2_{16} = 27.7$
prob. = .03

[1] ϕ's are correlations among the exogenous variables.

[2] ψ's is the covariance of the error term for the endogenous variable.

[3] Note that this inappropriate result is not significantly different from zero.

Table 4
Results for Second Submodel (See Figure 4)

For Both Groups	Parameter Estimate	Standard Error	T-Value
λ_1	1.0	-	-
λ_2	1.0	-	-
λ_3	.55	.22	2.51
λ_4	1.0	-	-
λ_5	-	-	-
λ_6	1.0	-	-
ϕ_{11}[1]	1.0	.186	5.39
ϕ_{22}	1.07	.42	2.57
ϕ_{33}	1.0	.186	5.39
ϕ_{12}	.26	.13	1.91
ϕ_{23}	-.06	.14	-.45
ϕ_{13}	-.09	.13	-.69
ψ_1[2]	.49	.13	3.81
δ_1	0.0	-	-
δ_2	-.07[3]	.37	-.19
δ_3	.68	.17	4.04
δ_4	0.0	-	-
δ_5	-	-	-
ϵ_1	0.0	-	-
For High Competition Group			
γ_1	-.58	.13	-4.33
γ_2	.04	.13	.28
γ_3	.32	.13	2.45
For Low Competition Group			
γ_1	-.56	.12	-4.54
γ_2	-.39	.19	-2.11
γ_3	-.01	.11	-.09

χ^2_{13} = 19.11, prob. = .12

[1] ϕ's are correlations among the exogenous variables.

[2] ψ's is the covariance of the error term for the endogenous variable.

[3] Note that this inappropriate result is not significantly different from zero.

of uncertainty on make-or-buy decisions vary across the high and low competition components. Thus the first hypothesis of this study is confirmed.

Looking now at the estimated effects of volume and technological uncertainty across the groups, we see that the second hypothesis is supported but in an unexpected and partial way. In the low competition group only volume uncertainty leads to a make decision. Furthermore, for high competition components technological uncertainty leads to a buy decision. These findings suggest that the interaction of uncertainty and asset specificity differs according to the type of uncertainty specified.

Finally, note that volume uncertainty has reasonable convergent and discriminant validity across the groups and that the strong significant effect of production costs on make-or-buy decisions is about the same in both groups, as assumed. Furthermore, the influence of volume uncertainty on the dependent variable for low competition components and of technological uncertainty for high competition components is approximately two-thirds the effect of production costs, a substantial proportion.

Discussion

The results of the present research show that although, as predicted, there are significant differences in the imputed transaction costs due to uncertainty between high and low competition components, these differences vary depending on the kind of uncertainty considered. The division studied here tends to bring component production in-house when supplier competition is low and volume but not technological uncertainty is high. In contrast, when the supplier market is competitive, the division buys those components which have high technological but not volume uncertainty.

That volume and not technological uncertainty influences make-or-buy decisions under conditions of high asset specificity suggests that mid-contract changes in demand are more perilous than changes in tooling

caused by component redesign. This result may hinge on the simplicity of the parts (first stage assembly) studied here and on the consequent ease with which changes in specifications may be implemented. The alteration of more complex components would entail more extensive changes in manufacturing equipment and greater coordination costs due to potential opportunism. Another explanation of this result is that because retooling is straightforwardly paid for by the buyer, recontracting due to technological change does not involve substantial negotiation; the costs of changes in volume, on the other hand, may be born by both parties and therefore induce more prolonged contracting which may be disadvantageous to the buyer when competition is low.

It is interesting, moreover, that the division is likely to shift technological but not volume uncertainty into its suppliers in highly competitive markets. This finding indicates that volume and technological uncertainty are controlled in fundamentally different ways. Whereas volume fluctuations create contracting hazards which contribute to internalizing producing a component, technological change poses no hazard but is imposed as implicit cost on suppliers when they are vying for the buyer's business. Thus the result for uncertainty surrounding the amount of output follows Williamson's theory, but that for change in transformation processes reflects to a greater extent Cyert and March's (1963) concept of uncertainty avoidance by managers. In a sense, therefore, while the findings for technological uncertainty are consistent with the transaction cost approach, they may indicate more a displacement of costs, associated with administering changes in production technology, from the firm to the market rather than a response to contracting costs, projected or already realized. Buyers are opportunistic, too.

In the present study we have tested a model of the extent to which the interaction between uncertainty and supplier market competition influences make-or-buy decisions for component production. Our results have shown general support for Williamson's proposition but have also indicated a tendency on the buyer's part to take advantage of supplier competition to reduce the costs associated with technological change. This tendency amplifies the transaction cost framework by posing questions of strategic de-integration. Further research should elaborate how the administration of transactions should be decomposed into reactive and strategic elements.

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